

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 02 August 2000 (02.08.00)	
International application No. PCT/EP99/09194	Applicant's or agent's file reference DID 15172-WO
International filing date (day/month/year) 26 November 1999 (26.11.99)	Priority date (day/month/year) 27 November 1998 (27.11.98)
Applicant LEE, Stephen, John	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
24 June 2000 (24.06.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Olivia RANAIVOJAONA Telephone No.: (41-22) 338.83.38
---	---

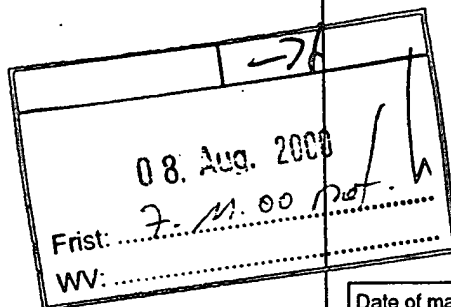
PCT

WRITTEN OPINION

(PCT Rule 66)

To:

BECKER, T.
BECKER & MÜLLER
Patentanwälte
Tumstrasse 22
D-40878 Ratingen
ALLEMAGNE



Date of mailing
(day/month/year)

07.08.2000

Applicant's or agent's file reference

DID 15172-WO

REPLY DUE

within 3 month(s)
from the above date of mailing

International application No.

PCT/EP99/09194

International filing date (day/month/year)

26/11/1999

Priority date (day/month/year)

27/11/1998

International Patent Classification (IPC) or both national classification and IPC

B22D41/50

Applicant

DIDIER-WERKE AG et al.

1. This written opinion is the first drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain document cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

3. The applicant is hereby invited to reply to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4.4.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 27/03/2001

Name and mailing address of the international preliminary examining authority:

 European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer / Examiner

Flink, E

Formalities officer (incl. extension of time limits)

Luck, A

Telephone No. +49 89 2399 2665



PCT

To:

BECKER, T.
BECKER & MÜLLER
Patentanwälte
Turmstrasse 22
D-40878 Ratingen
ALLEMAGNE

→	
19. Feb. 2001	
Frist:	/
WV:	/

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing
(day/month/year) 16.02.2001

Applicant's or agent's file reference
DID 15172-WO

IMPORTANT NOTIFICATION

International application No.
PCT/EP99/09194

International filing date (day/month/year)
26/11/1999

Priority date (day/month/year)
27/11/1998

Applicant
DIDIER-WERKE AG et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

BEST AVAILABLE COPY

Name and mailing address of the IPEA/

 European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer

Nilles, F

Tel. +49 89 2399-2931



PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)


Applicant's or agent's file reference DID 15172-WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/EP99/09194	International filing date (day/month/year) 26/11/1999	Priority date (day/month/year) 27/11/1998
International Patent Classification (IPC) or national classification and IPC B22D41/50		
Applicant DIDIER-WERKE AG et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:
 - ☒ Basis of the report
 - ☐ Priority
 - ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - ☐ Lack of unity of invention
 - ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - ☐ Certain documents cited
 - ☒ Certain defects in the international application
 - ☒ Certain observations on the international application

Date of submission of the demand 24/06/2000	Date of completion of this report 16.02.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Flink, E Telephone No. +49 89 2399 2919



I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*).

Description, pages:

1-8 as originally filed

Claims, No.:

1-10 as originally filed

Drawings, sheets:

1/3-3/3 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	1
Inventive step (IS)	Claims	2-10
Industrial applicability (IA)	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

BEST AVAILABLE COPY

Re Item VIII

Certain observations on the international application

a) Claim 1 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added.

b) Claim 10 contains a reference to the description and the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

BEST AVAILABLE COPY

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following document:

D1: EP-A-0149164

2. Document D1 discloses a refractory pouring device comprising a ceramic body having a ceramic pouring tube element and a ceramic support element. Between said elements there is provided a shock-absorbing interface zone wherein there is provided a material the properties of which are such that it is substantially solid at ambient temperatures but becomes deformable at the elevated temperatures experienced during metal teeming (see claim 1; page 8, line 19 - page 12, line 32 and figures 1-5). Further from the content of D1 it is clear that the support element is adapted to be received within a metallic can.

Therefore, the subject-matter of claim 1 lacks novelty (Article 33(2) PCT).

3. The features of claims 2-10 are either derivable from D1 or come further within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be contemplated in advance.

Consequently, the subject-matter of said claims does not involve an inventive step (Article 33(3) PCT).

Re Item VII

Certain defects in the international application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in document D1 is not mentioned in the description, nor is this document identified therein.

BEST AVAILABLE COPY

Re Item VIII

Certain observations on the international application

a) Claim 1 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added.

b) Claim 10 contains a reference to the description and the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

The object of the invention is to obviate or mitigate the risks of exaggerated thermo mechanical stresses in pouring tube elements (see page 4, lines 14-16).

This object is achieved with the refractory device according to the independent claim 1.

The documents cited in the International Search Report (ISR) do not disclose a refractory device having all the features of the subject-matter of claim 1; in particular they do not mention a refractory device, comprising a ceramic pouring tube element, supported in a metallic can, in which a ceramic support element is encapsulated and a shock-absorbing interface zone between said metallic can and the ceramic pouring tube element.

Further the documents cited in the ISR do not give any indication that the above mentioned object can be achieved with such a device.

Therefore, the subject-matter of claim 1 is novel and involves an inventive step and meets the requirements of Articles 33(2) and 33(3) PCT.

The dependent claims 2-9 relate to further embodiments of the subject-matter of claim 1 and meet likewise the requirements of Articles 33(2) and 33(3) PCT.

Re Item VII**Certain defects in the international application**

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document EP-A-0149164 is not mentioned in the description, nor is this document identified therein.
2. The description is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

Re Item VIII

Certain observations on the international application

1. Claim 4 referring to claim 3 lacks clarity in that the interface zone of claim 3 already comprises a ceramic material.
2. For consistency with claim 1, the term "support element" in claim 5 should have been replaced by the term "metallic can".

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP99/09194

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1-9
	No: Claims
Inventive step (IS)	Yes: Claims 1-9
	No: Claims
Industrial applicability (IA)	Yes: Claims 1-9
	No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP99/09194

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*

Description, pages:

1-8 as originally filed

Claims, No.:

1-9 as received on 26/08/2000 with letter of 25/08/2000

Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

BEST AVAILABLE COPY

PC

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) DID 15172-WO

Box No. I TITLE OF INVENTION

Improvements in or relating to refractory products

Box No. II APPLICANT

Name and address (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

DIDIER-WERKE AG
27-31, Didier-Strasse
DE-65203 Wiesbaden
DE

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State (that is, country) of nationality:
DEState (that is, country) of residence:
DEThis person is applicant
for the purposes of:☐ all designated
States☒ all designated States except
the United States of America☐ the United States
of America only☐ the States indicated in
the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

LEE, Stephen, John
6, River View Crescent
Cardross G51 GLT - Great Britain
GB

This person is:

☐ applicant only☒ applicant and inventor☐ inventor only (If this check-box
is marked, do not fill in below.)

State (that is, country) of nationality:

GB

State (that is, country) of residence:

GB

This person is applicant
for the purposes of:☐ all designated
States☐ all designated States except
the United States of America☒ the United States
of America only☐ the States indicated in
the Supplemental Box☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

☒ agent☐ common representative

Name and address (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

BECKER, Thomas U.
22, Turmstrasse
DE-40878 Ratingen
DE

Telephone No.

02102/20240

Facsimile No.

02102-202420

Teleprinter No.

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. V DESIGNATION STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|--|--|
| <input checked="" type="checkbox"/> AE United Arab Emirates | <input checked="" type="checkbox"/> LR Liberia |
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> LS Lesotho |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> LT Lithuania |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> LV Latvia |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> MD Republic of Moldova |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> BB Barbados | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BG Bulgaria | |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> MN Mongolia |
| <input checked="" type="checkbox"/> BY Belarus | <input checked="" type="checkbox"/> MW Malawi |
| <input checked="" type="checkbox"/> CA Canada | <input checked="" type="checkbox"/> MX Mexico |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> SD Sudan |
| <input checked="" type="checkbox"/> ES Spain | <input checked="" type="checkbox"/> SE Sweden |
| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SG Singapore |
| <input type="checkbox"/> GB United Kingdom | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> GD Grenada | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> GE Georgia | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
| <input checked="" type="checkbox"/> ID Indonesia | <input checked="" type="checkbox"/> UA Ukraine |
| <input checked="" type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> IN India | <input checked="" type="checkbox"/> US United States of America |
| <input checked="" type="checkbox"/> IS Iceland | |
| <input checked="" type="checkbox"/> JP Japan | <input checked="" type="checkbox"/> UZ Uzbekistan |
| <input checked="" type="checkbox"/> KE Kenya | <input checked="" type="checkbox"/> VN Viet Nam |
| <input checked="" type="checkbox"/> KG Kyrgyzstan | <input checked="" type="checkbox"/> YU Yugoslavia |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | <input checked="" type="checkbox"/> ZA South Africa |
| <input checked="" type="checkbox"/> KR Republic of Korea | <input checked="" type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> KZ Kazakhstan | |
| <input checked="" type="checkbox"/> LC Saint Lucia | |
| <input checked="" type="checkbox"/> LK Sri Lanka | |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet.

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

Supplemental Box

If the Supplemental Box is not used, this sheet should not be included in the request.

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..."
[indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which
the space was insufficient, in particular:
 - (i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write
"Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The
country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated
below;
 - (ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked:
in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III"
(as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where
applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;
 - (iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes
of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or
"Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the
inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for
the purposes of which the named person is inventor;
 - (iv) if, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV"
and indicate for each further agent the same type of information as required in Box No. IV;
 - (v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition,"
or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-
in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of
each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing
of the parent application;
 - (vi) if, in Box No. VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of
Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;
 - (vii) if, in Box No. VI, the earlier application is an ARIPO application: in such case, write "Continuation of Box No. VI", specify the
number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for
the Protection of Industrial Property for which that earlier application was filed.
2. If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from
the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the
name or two-letter code of each State so excluded.
3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning non-prejudicial
disclosures or exceptions to lack of novelty: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack
of novelty" and furnish that statement below.

Continuation of Box No. IV

Further Agent

MÜLLER, Karl-Ernst
22, Turmstrasse
DE-40878 Ratingen
DE

BEST AVAILABLE COPY

European Patent Office

80298 Munich

25. August 2000

PCT/EP99/09194

Didier-Werke AG

Attorney's file: DID 15172-WO ha12

Reference is made to the written opinion of 7 August 2000:

Please find enclosed amended claims 1-9, replacing -without prejudice for the time being- originally filed claims 1-10.

Amended claim 1 is based on originally filed claim 1 and the description page 6, last paragraph to page 7, first paragraph.

New claim 1 differs from the originally filed main claim just in defining the claimed construction more precisely, as it is Applicant's impression that the construction of Applicant's refractory device has not been fully understood by the Examiner and insofar document D1 has been regarded as novelty destroying.

Additionally as Annex BM1 figure 6 of the pending application and figure 1 of D1 have been copied onto one sheet and coloured.

While Applicant's device comprises a ceramic pouring tube element 10 (yellow), being a one piece element, the nozzle of D1 is a two piece element (elements 8, 9).

While both elements 8, 9 form the nozzle and the metal melt is poured along both elements in D1 the metal melt is guided just along the one piece pouring tube element 10 in Applicant's device.

While there is no disclosure in D1 of how to support the nozzle (at its upper end) the disclosure is limited to the two piece element at the lower nozzle end.

Contrary to that Applicant's device claims for protection of a combination of said ceramic pouring tube element, supported at its upper end in a metallic can in which the ceramic support element is encapsulated.

It is further claimed that between the said can (ceramic support element) and the pouring tube a shock-absorbing interface zone is placed.

As there is no metallic can, no ceramic support element and no shock-absorbing interface zone between a metallic can and a ceramic pouring tube element disclosed in D1 (but just an interface layer between elements 8,9) the claimed refractory device does not only seem novel over D1 but as well based on inventive height.

It is requested to place the description in conformity with the amended claims after novelty and inventive height have been accepted.

Subclaims 2-9 have been amended by adding numerals. Originally filed claim 10 has been cancelled.

Earliest prosecution will be appreciated.


Thomas U. Becker

Amended claims
Annex BM1

PCT/EP99/09194

CLAIMS

1. A refractory device for use in the teeming of molten metal, comprising a ceramic pouring tube element 10, supported in a metallic can 11, in which a ceramic support element 12 is encapsulated and a shock-absorbing interface zone 13 between said metallic can 11 and the ceramic pouring tube element 10, wherein there is provided a material the thermal properties of which are such that it is substantially solid at ambient temperatures but becomes deformable at elevated temperatures experienced during metal teeming.

2. A refractory device according to claim 1, wherein the material selected for use in the interface zone 13 is structurally solid at temperatures up to about 700°C and becomes deformable without any appreciable chemical degradation at temperatures above about 700 °C.

3. A refractory device according to claim 1 or 2, wherein the material providing the interface zone 13 comprises a pyroplastic ceramic material.

4. A refractory device according to claim 3, wherein the interface zone 13 comprises a ceramic material such as a paste or bonding agent or additional structural ceramic element.

5. A refractory device according to claim 3, wherein the pyroplastic material is a frittable composition applied over at least one of the co-operating assembly surfaces of the pouring tube element and the support element.

6. A refractory device according to any one of the preceding claims, wherein the ceramic support element 12 is fully encapsulated within the metallic can 11, and fits with and around the upper part of the pouring tube element 10 by virtue

BEST AVAILABLE COPY

of said ceramic support 12 element having an internal profile corresponding sufficiently to the external profile of the pouring tube.

7. A refractory device according to claim 6, wherein the respective profiles are such as to provide corresponding interferences fits surfaces or otherwise matching.

8. A refractory device according to any one of the preceding claims, wherein the ceramic support element 12 is pre-formed from a ceramic material of low thermal conductivity, or formed *in situ* by a suitable casting operation.

9. A refractory device according to any one of the preceding claims, wherein the refractory device is finished to suit its intended purpose.

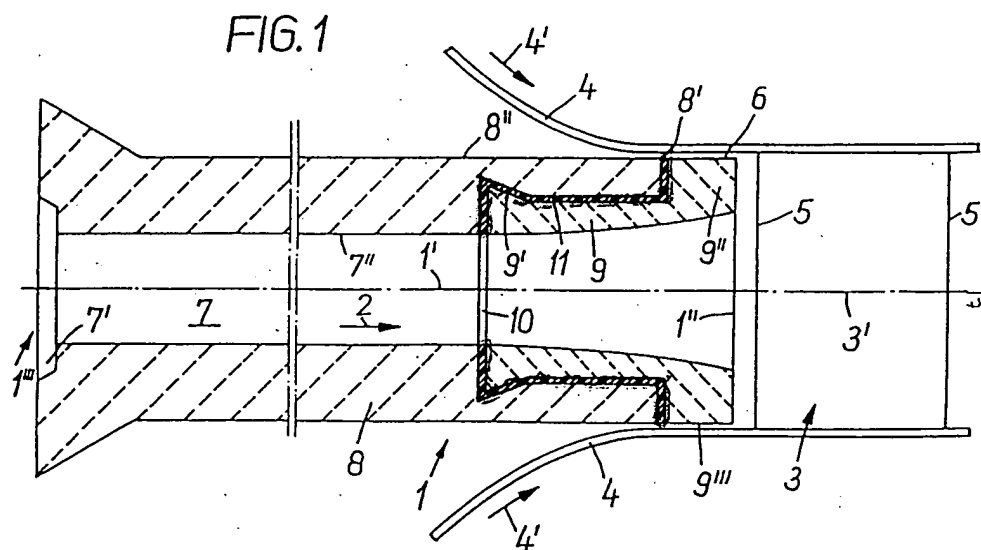
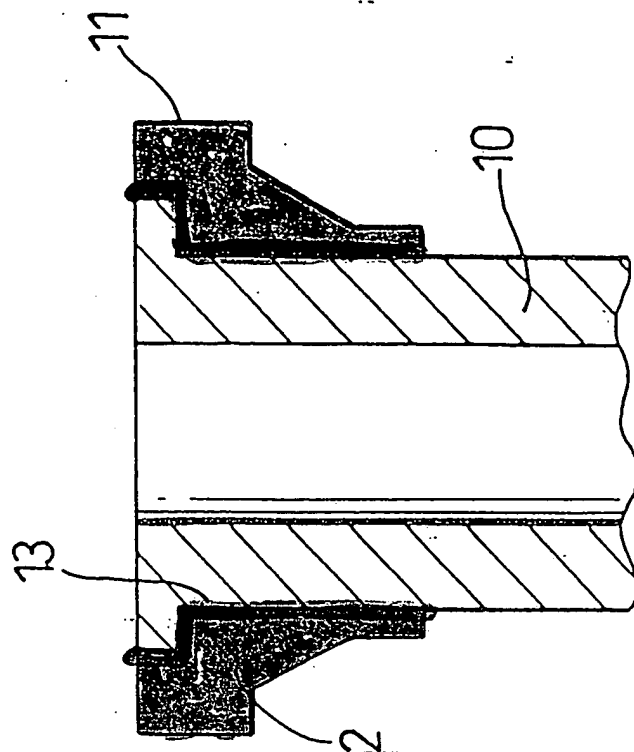


FIG. 1



600

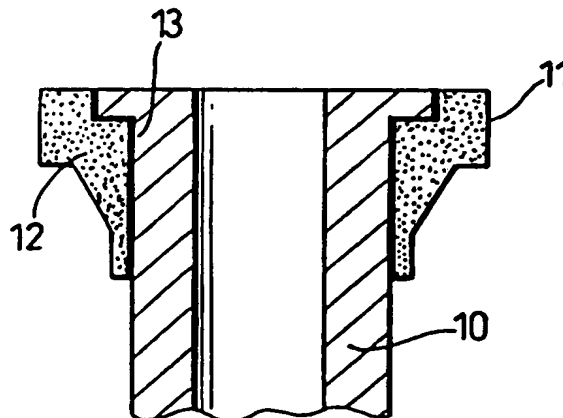


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : B22D 41/50, 41/28	A1	(11) International Publication Number: WO 00/32337 (43) International Publication Date: 8 June 2000 (08.06.00)
(21) International Application Number: PCT/EP99/09194 (22) International Filing Date: 26 November 1999 (26.11.99) (30) Priority Data: 9825986.4 27 November 1998 (27.11.98) GB (71) Applicant (for all designated States except US): DI-DIER-WERKE AG [DE/DE]; 1, Abraham-Lincoln-Strasse, D-65189 Wiesbaden (DE). (72) Inventor; and (75) Inventor/Applicant (for US only): LEE, Stephen, John [GB/GB]; 6, River View Crescent, Cardross G51 6LT (GB). (74) Agents: BECKER, Thomas, U. et al.; Turmstrasse 22, D-40878 Ratingen (DE).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: IMPROVEMENTS IN OR RELATING TO REFRACTORY PRODUCTS**(57) Abstract**

A refractory device for use in the teeming of molten metal comprising a ceramic body having a ceramic pouring tube element (10, 20) and a ceramic support element (12, 22), said support element being adapted to be received within a metallic can (11, 21), and there is provided between said elements a pyroplastic shock-absorbing interface zone (13, 24) wherein there is provided a material the thermal properties of which are such that it is substantially solid at ambient temperatures but become deformable at the elevated temperatures experienced during metal teeming.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

INTERNATIONAL SEARCH REPORT

National Application No

PCT/EP 99/09194

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B22D41/50 B22D41/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B22D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 149 164 A (KRUPP GMBH) 24 July 1985 (1985-07-24) page 8, line 19 -page 12, line 6; figures 1-5	1-10
A	WO 88 06500 A (THOR CERAMICS LTD) 7 September 1988 (1988-09-07) figures 1,3,5	1
A	WO 98 42465 A (NORTH AMERICAN REFRACTORIES) 1 October 1998 (1998-10-01) figure 1	1
A	EP 0 282 247 A (THOR CERAMICS LTD) 14 September 1988 (1988-09-14) abstract; figure 1	1

☐ Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

17 March 2000

Date of mailing of the international search report

29/03/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Mailliard, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 99/09194

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0149164 A	24-07-1985	DE 3401024 A AT 30865 T	25-07-1985 15-12-1987
WO 8806500 A	07-09-1988	AT 90896 T DE 3882041 A DE 3882041 T EP 0346378 A GB 2229662 A, B US 5348202 A US 5198126 A	15-07-1993 29-07-1993 21-10-1993 20-12-1989 03-10-1990 20-09-1994 30-03-1993
WO 9842465 A	01-10-1998	US 5866022 A AU 6868298 A EP 0969942 A	02-02-1999 20-10-1998 12-01-2000
EP 0282247 A	14-09-1988	DE 3873790 A	24-09-1992

Improvements in or relating to refractory products

This invention relates to improvements in or relating to refractory products and, more particularly, to improvements in refractory products used in the handling of molten metals to increase reliability under high temperature operating conditions.

Metal teeming, and in particular the casting of steel usually begins with the metal being melted and transferred to a vessel, e.g. a ladle or tundish. Refractory devices are required, amongst other things, for the regulation of the flow of the molten metal exiting from a nozzle mounted in the bottom of the vessel. In the casting of steel, this is typically applied through an opening in the base of the vessel via nozzles and shrouds into a water-cooled mould. Refractory devices such as sub-entry shrouds and pouring nozzles are often at least partly submerged for long periods of time in the molten metal during the metal teeming process and are therefore subject to high temperatures and stresses during the effective lifetime of the device.

In a typical teeming process, metal is melted in a furnace, transferred first to a ladle and then to a tundish from which it flows in a controlled manner into a cooled mould. A flow control valve is provided in the tundish comprising a flow control stopper rod selectively engageable with an outlet nozzle seat. The stopper would normally be raised off the seat by a certain amount to achieve a particular rate of flow of molten metal through the valve to ultimately cast a product in a mould.

The teeming apparatus would usually include a pouring nozzle or a shroud located beneath the flow control valve either of which may be immersed in melt as the casting operation proceeds.

In an exchange nozzle casting mechanism, the exchange pouring nozzle or shroud is supported beneath a stopper upper nozzle and stationary plate assembly which is used for sealing off the flow of molten metal above the pouring nozzle or shroud to allow the pouring nozzle or shroud to be changed during the teeming process.

EP-A-0 346 378 describes the development of a monotube configuration and compares that to a two part plate and tube assembly generally known and used within an exchange nozzle casting mechanism as described above. The pouring tube element combines a body of high thermal shock resistance and corrosion resistance with a sliding plate surface able to form a tight closure against the stationary components of the mechanism. The sliding plate surface also incorporates a hard edge to permit cutting through any metal skin which may form during the casting operation and which may restrict free movement of the exchange monotube during the replacement procedure.

An important advantage of the monotube configuration over the original fired plate and tube or cast plate and tube assemblies was the elimination of generally horizontal joints connecting the internal casting bore of the tube with the external atmosphere, thereby eliminating the risk of air ingress or metal leakage across this joint region.

As casting conditions have become more severe and service life requirements of refractory products increased, new demands have been placed on the monotube elements of an exchange of an exchange nozzle casting mechanism.

In meeting these demands alternative compositions for the pouring tube element have been developed making it possible to maintain the plate surface and cutting edge configuration whilst providing improved corrosion and erosion resistance. These improved materials for the pouring tube element of a monotube do however exhibit different thermo-mechanical properties from the original materials as shown in the following table:

MONOTUBE POURING TUBE ELEMENT COMPOSITIONS

CONVENTIONAL

HIGH CORROSION RESISTANCE

40	Al ₂ O ₃ %
18	SiO ₂ %
28	C%
8	ZrO ₂ %

64
6
24
6

4	SiC%	-
2.38	Bulk density g/ml	2.6
0.35	Thermal Expansion% 0-1000	0.52

5 In operation, it has been shown that whilst the overall criteria for
performance improvement has been met there is an increased risk that
thermo mechanical stresses arising at the outset of casting can cause an
external micro-crack fracture at the section change between the head and
body portions of the pouring tube. In many instances, this micro-crack
10 feature is contained by the inherent integrity of the ceramic body. This
results in no operational problem, but in extreme cases it is possible for the
external micro-crack fracture to propagate across the ceramic wall of the tube
to the inner bore. This allows either air ingress or metal leakage, both of
which cause termination of the cast and possible damage to the exchange
15 nozzle casting mechanism.

Studies of the behaviour of the conventional metallic can and pouring
tube element showed that the metallic can, essential to provide the accurate
geometry required for a precise fit into the exchange nozzle casting
20 mechanism could also act to transfer heat from the pouring element into the
cooled mechanical mechanism, thereby increasing the thermal gradient at
this critical point. Additionally at the temperatures experienced during
preheat prior to cast start up the lower region of the can would reach a
temperature of approx 900°C at which the relatively mild steel from which it is
25 formed loses its rigidity and ceases to provide the desirable structural support
below the section change.

A further development of the monotube concept is shown in US 5 866
022 which describes the assembly of a co-pressed, mixed material tube
30 element, as described by EP A 0 346 378 adapted to the desired operational
configuration by use of castable materials directly infilling the void between
the outer surface of the tube and the inner surface of the metallic support
element. This is shown in Figure 4.

35 Whilst this design concept has shown benefits in terms of reduced
incidence of microcrack formation causing in service failures, examination of

used pieces shows that a risk remains that a crack will propagate from the angle between the tube and plate sections of the co-compressed tube element, as shown in Fig 5. This behaviour is not of such severe consequence as the failures of the type illustrated in Fig 3 as it does not necessarily result in molten steel leakage. It is however desirable to eliminate this risk.

Extensive computer simulation of the thermo-mechanical stresses arising during preheat and start up of casting has identified the possibility of minimising the stresses leading to such micro crack formation and propagation, by minimising the thermal gradient across the tubular pouring element, providing continuing support below any section change and optimisation of the external geometry of the tubular pouring element.

An object of this invention is to obviate or mitigate the risks of exaggerated thermo mechanical stresses in the new generation of pouring tube elements, and this is found to be achievable by revising both the design of the pouring tube element and the manner in which it is contained within the can. It will be recalled that location of the refractory within the support can requires care to provide the correct geometrical configuration to allow effective operation of the exchange tube mechanism and maintain the principle of no direct horizontal connection from the bore to the exterior other than the machined sliding surface.

According to one aspect of the present invention there is provided a refractory device for use in the teeming of molten metal comprising a ceramic body having a ceramic pouring tube element and a ceramic support element, said support element being adapted to be received within a metallic can, and there is provided between said elements a shock-absorbing interface zone wherein there is provided a material the thermal properties of which are such that it is substantially solid at ambient temperatures but becomes deformable at the elevated temperatures experienced during metal teeming.

Thus, the interface zone provides continuity of mechanical support to the body portion when in the substantially solid (cool ambient temperature) condition to ensure structural integrity of the assembled refractory device, but deforms sufficiently to provide a buffer against sudden differential thermal

stresses, thereby minimising the risks of micro-crack fracture through the body portion due to thermo mechanical stresses during pre-hat and at the start of the casting operation.

5 Advantageously, the material selected for use in the interface zone is structurally solid at temperatures up to about 700°C and becomes deformable without any appreciable chemical degradation at temperatures above about 700°C. Preferably the material providing the interface zone comprises a pyroplastic ceramic material.

10 Preferably, the interface zone comprises a ceramic material such as a paste or bonding agent or additional structural ceramic element exhibiting the aforesaid properties.

15 Conveniently, the pyroplastic material is a fritttable composition applied over at least one of the co-operating assembly surfaces of the pouring tube element and the ceramic support element.

20 The ceramic support element is normally fully encapsulated within the metallic can, and fits with and around the upper part of the pouring tube element by virtue of said ceramic support element having an internal profile corresponding sufficiently to the external profile of the pouring tube. Conveniently, the respective profiles are such as to provide corresponding interference fit surfaces or otherwise matching, e.g. tapering surfaces to
25 facilitate assembly, and in-fill or insertion of the required shock-absorbing interface zone material.

30 The ceramic support element may be pre-formed from a ceramic material of low thermal conductivity, or formed *in situ* by a suitable casting operation of a type familiar to those in this art.

35 The refractory device may be otherwise finished as is known in the art to suit its intended purpose, e.g. with regard to provision of flat surfaces and outlet nozzles etc.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a cross-sectional view of a two-part plate and tube configuration in accordance with prior art;

Figure 2 is a cross-sectional view of a prior art monotube configuration;

Figure 3 is a cross-sectional view of a monotube configuration showing a stress micro-crack fracture of the type minimised by the present invention;

Figure 4 is a section of modified version of monotube assembly as per US 5 866 022.

Figure 5 is a diagram showing crack mark observed during service trials of such a configuration.

Figure 6 is a cross-sectional view of a refractory device according to one aspect of the present invention; and

Figure 7 is a cross-sectional view of a refractory device according to a second aspect of the present invention.

Referring now to the figures, there is shown in Figures 1-3 cross-sectional views of prior art refractory devices including the two-part plate and tube assembly known generally in the prior art and the early monotube configuration discussed above.

Figure 6 is a cross-sectional view of a refractory product according to one aspect of the present invention. This shows a refractory pouring device having a ceramic pouring tube element **10** such as for example of a pouring nozzle or sub entry shroud. The pouring tube element is supported in a metallic can **11**, which maintains the desired geometrical configuration of the tube for mechanical integrity of the pouring mechanism. A low thermal conductivity ceramic support element **12** is encapsulated within the metallic

can, and fits with and around the upper part of the pouring tube element, by virtue of said ceramic support element having an internal profile corresponding sufficiently to the external profile of the pouring tube. Here, a stepped shoulder, interference fit arrangement is illustrated.

The low thermal conductivity of the ceramic support element reduces heat losses from the pouring tube during metal teeming thereby minimising the differential thermal stresses experienced by the pouring tube which could lead to propagation of stress micro-crack features.

A shock absorbing interface zone 13 is formed between the low conductivity ceramic support element 12 and the pouring tube element 10. The zone is formed in accordance with one aspect of the invention by a layer of pyroplastic ceramic cement, the properties of which are chosen to provide optimum mechanical strength in temperatures below about 700°C to support the pouring tube during preheating operations and manipulation. The cement has a degree of pyroplasticity at elevated temperatures encountered during use of the pouring tube in the metal teeming process to absorb any residual differential stresses, which may be created during this process.

By way of example, the pyroplastic ceramic cement may be formed from an alumina-silicate mixture with an addition of fluxing agents to generate the pyroplastic behaviour. A typical analysis of said pyroplastic cement being alumina 20%, silica 54%, potassium oxide 6%, boric oxide 12% and sodium oxide 8%. Such a composition will provide for progressive melting from about 700°C to impart plasticity to the layer.

Figure 7 illustrates a further embodiment of the present invention wherein the pouring tube element 20 is coated with a pyroplastic surface layer 24 on its upper region to provide the desired low temperature rigidity and high temperature malleability. The coated tube is then encapsulated within the metallic can by a ceramic concrete 22, which provides mechanical support to the pouring tube during the teeming process. Furthermore, the ceramic support element reduces heat losses from the pouring tube during metal teeming thereby minimising the differential thermal stresses experienced by the pouring tube which lead to propagation of stress micro-crack features.

In use of either of the refractory device described above, the pouring tube is mounted beneath the orifice of a vessel (not shown). Molten metal is poured through the pouring tube for example into a water-cooled mould (not shown). During the metal casting process, the external temperature of the pouring tube rises typically to between 700°C and 900°C. At temperatures up

to about 700°C, the pyroplastic interface zone (13; 24) between the pouring tube element (10; 20) and the ceramic element (12; 22) encapsulated in the metallic can remains solid and provides structural continuity and additional mechanical support to the pouring tube. Thereby, structural integrity of the refractory device is provided for e.g. during handling for transport purposes, and initially during assembly into a pouring mechanism and pre-heat. At temperatures above about 700°C however, at which differential thermal stresses between the pouring tube and the support therefor in the metallic can would have previously possibly caused a stress micro-crack fracture of the pouring tube, the pyroplastic interface zone becomes deformable, thereby minimising differential thermal stresses experienced by the pouring tube in the region supported by the metallic can. Therefore, in this way the possibility of micro-crack fracture through the refractory device and failure thereof is obviated or mitigated. Thus, the present invention results in an improved refractory device that has better reliability and is less prone to damage from differential stress micro-crack features.

CLAIMS

1. A refractory device for use in the teeming of molten metal comprising a ceramic body having a ceramic pouring tube element and a ceramic support
5 element, said support element being adapted to be received within a metallic can, and there is provided between said elements a shock-absorbing interface zone wherein there is provided a material the thermal properties of which are such that it is substantially solid at ambient temperatures but become deformable at the elevated temperatures experienced during metal teeming.
10
2. A refractory device according to claim 1, wherein the material selected for use in the interface zone is structurally solid at temperatures up to about 700°C and becomes deformable without any appreciable chemical degradation at temperatures above about 700°C.
15
3. A refractory device according to claim 1 or 2, wherein the material providing the interface zone comprises a pyroplastic ceramic material.
4. A refractory device according to claim 3, wherein the interface zone
20 comprises a ceramic material such as a paste or bonding agent or additional structural ceramic element.
5. A refractory device according to claim 3, wherein the pyroplastic material is a fritttable composition applied over at least one of the co-operating
25 assembly surfaces of the pouring tube element and the support element.
6. A refractory device according to any one of the preceding claims, wherein the ceramic support element is fully encapsulated within the metallic can, and fits with and around the upper part of the pouring tube element by
30 virtue of said ceramic support element having an internal profile corresponding sufficiently to the external profile of the pouring tube.
7. A refractory device according to claim 6, wherein the respective profiles are such as to provide corresponding interference fits surfaces or otherwise
35 matching.

8. A refractory device according to any one of the preceding claims, wherein the ceramic support element is pre-formed from a ceramic material of low thermal conductivity, or formed *in situ* by a suitable casting operation.
- 5 9. A refractory device according to any one of the preceding claims, wherein the refractory device is finished to suit its intended purpose.
10. A refractory device substantially as hereinbefore described with reference to and as shown in Figures 6 or 7 of the accompanying drawings.

1/3

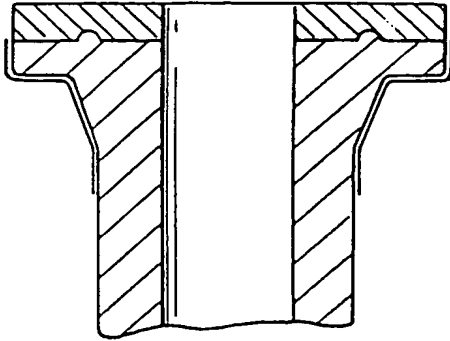


Fig. 1 (PRIOR ART)

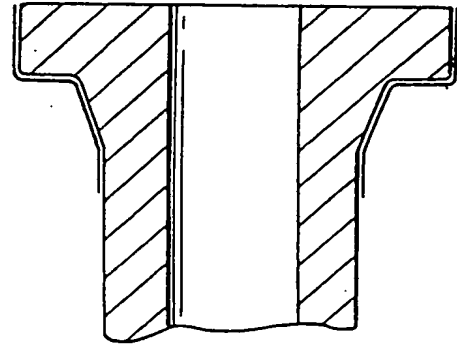


Fig. 2 (PRIOR ART)

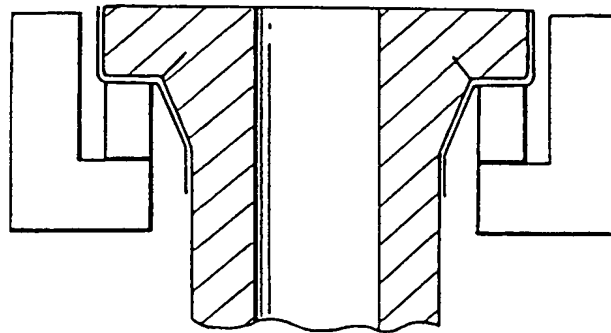


Fig. 3 (PRIOR ART)

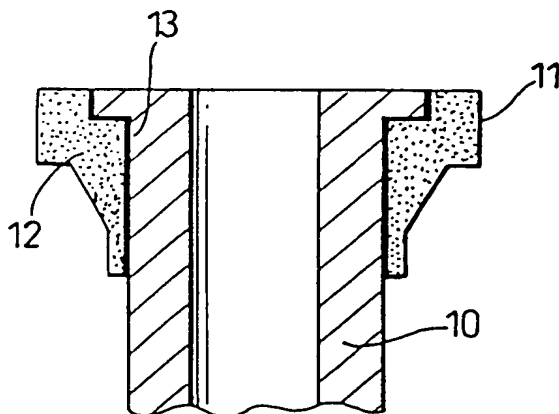


Fig. 6

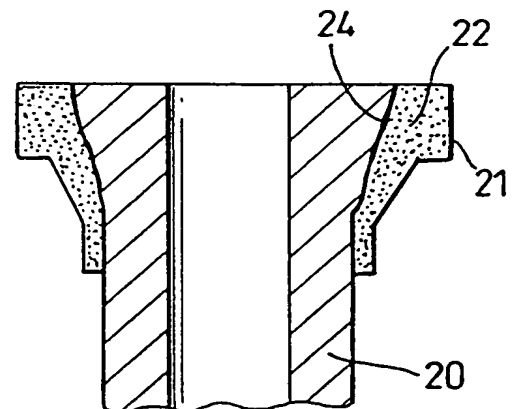


Fig. 7

SCALE 1:5

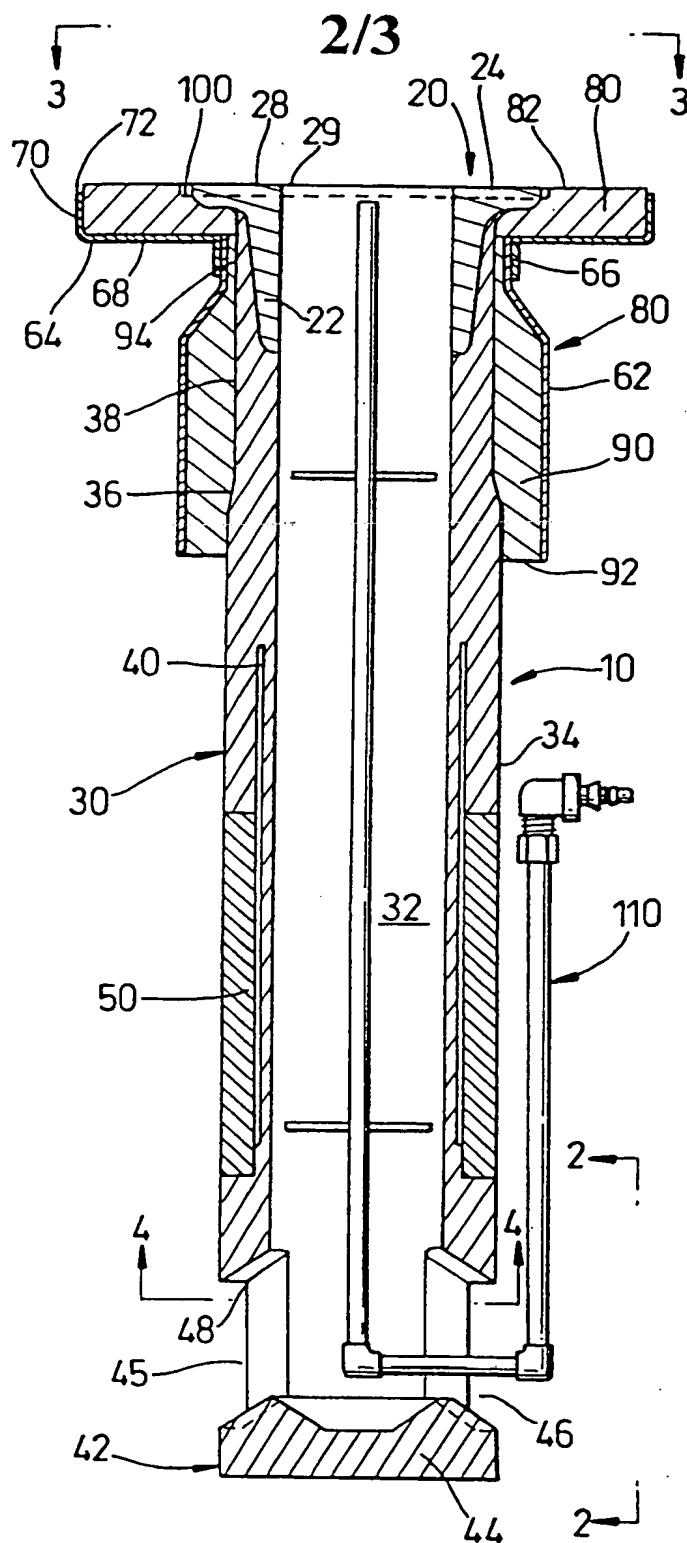
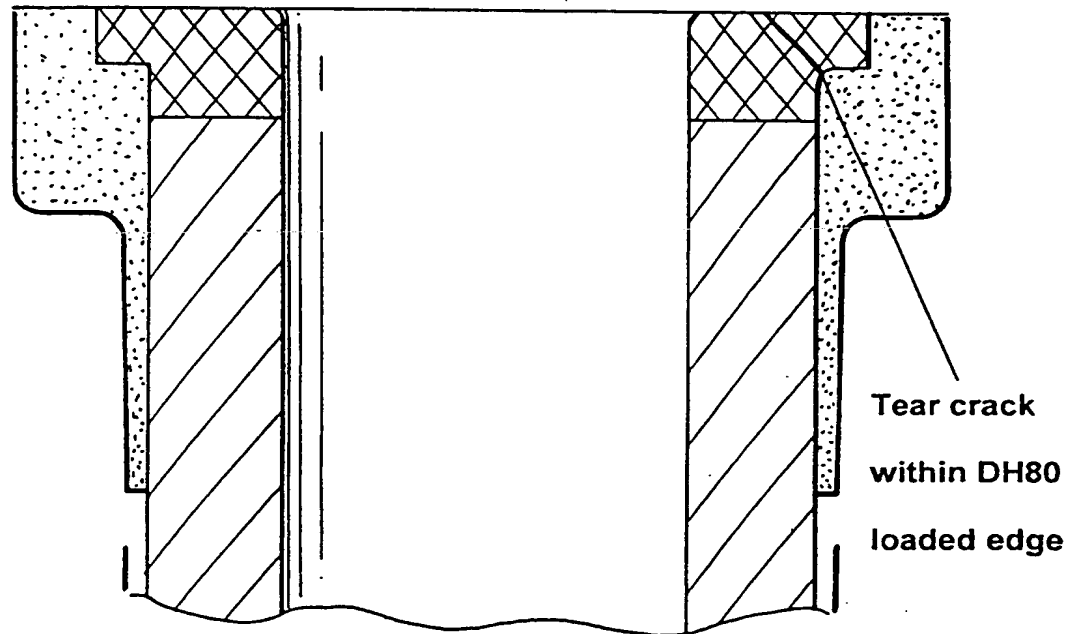


Fig. 4

3/3

*Fig. 5*

Crack propagation
in MT-1597

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference DID 15172-W0	FOR FURTHER ACTION		see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/EP 99/09194	International filing date (day/month/year) 26/11/1999	(Earliest) Priority Date (day/month/year) 27/11/1998	
Applicant DIDIER-WERKE AG et al.			

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (see Box II).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

6

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No.

EP 99/09194

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B22D41/50 B22D41/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B22D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 149 164 A (KRUPP GMBH) 24 July 1985 (1985-07-24) page 8, line 19 -page 12, line 6; figures 1-5	1-10
A	WO 88 06500 A (THOR CERAMICS LTD) 7 September 1988 (1988-09-07) figures 1,3,5	1
A	WO 98 42465 A (NORTH AMERICAN REFRACTORIES) 1 October 1998 (1998-10-01) figure 1	1
A	EP 0 282 247 A (THOR CERAMICS LTD) 14 September 1988 (1988-09-14) abstract; figure 1	1

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

17 March 2000

Date of mailing of the international search report

29/03/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Mailliard, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

/EP 99/09194

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0149164	A	24-07-1985	DE 3401024 A AT 30865 T	25-07-1985 15-12-1987
W0 8806500	A	07-09-1988	AT 90896 T DE 3882041 A DE 3882041 T EP 0346378 A GB 2229662 A,B US 5348202 A US 5198126 A	15-07-1993 29-07-1993 21-10-1993 20-12-1989 03-10-1990 20-09-1994 30-03-1993
W0 9842465	A	01-10-1998	US 5866022 A AU 6868298 A EP 0969942 A	02-02-1999 20-10-1998 12-01-2000
EP 0282247	A	14-09-1988	DE 3873790 A	24-09-1992

CLAIMS

1. A refractory device for use in the teeming of molten metal comprising a ceramic body having a ceramic pouring tube element and a ceramic support
5 element, said support element being adapted to be received within a metallic can, and there is provided between said elements a shock-absorbing interface zone wherein there is provided a material the thermal properties of which are such that it is substantially solid at ambient temperatures but become deformable at the elevated temperatures experienced during metal teeming.
10
2. A refractory device according to claim 1, wherein the material selected for use in the interface zone is structurally solid at temperatures up to about 700°C and becomes deformable without any appreciable chemical degradation at temperatures above about 700°C.
15
3. A refractory device according to claim 1 or 2, wherein the material providing the interface zone comprises a pyroplastic ceramic material.
4. A refractory device according to claim 3, wherein the interface zone
20 comprises a ceramic material such as a paste or bonding agent or additional structural ceramic element.
5. A refractory device according to claim 3, wherein the pyroplastic material is a fritttable composition applied over at least one of the co-operating
25 assembly surfaces of the pouring tube element and the support element.
6. A refractory device according to any one of the preceding claims, wherein the ceramic support element is fully encapsulated within the metallic can, and fits with and around the upper part of the pouring tube element by
30 virtue of said ceramic support element having an internal profile corresponding sufficiently to the external profile of the pouring tube.
7. A refractory device according to claim 6, wherein the respective profiles are such as to provide corresponding interference fits surfaces or otherwise
35 matching.

8. A refractory device according to any one of the preceding claims, wherein the ceramic support element is pre-formed from a ceramic material of low thermal conductivity, or formed *in situ* by a suitable casting operation.

5 9. A refractory device according to any one of the preceding claims, wherein the refractory device is finished to suit its intended purpose.

10. A refractory device substantially as hereinbefore described with reference to and as shown in Figures 6 or 7 of the accompanying drawings.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/09194

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B22D41/50 B22D41/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 B22D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 149 164 A (KRUPP GMBH) 24 July 1985 (1985-07-24) page 8, line 19 -page 12, line 6; figures 1-5	1-10
A	WO 88 06500 A (THOR CERAMICS LTD) 7 September 1988 (1988-09-07) figures 1,3,5	1
A	WO 98 42465 A (NORTH AMERICAN REFRATORIES) 1 October 1998 (1998-10-01) figure 1	1
A	EP 0 282 247 A (THOR CERAMICS LTD) 14 September 1988 (1988-09-14) abstract; figure 1	1

☐ Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
 "E" earlier document but published on or after the international filing date
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
 "&" document member of the same patent family

Date of the actual completion of the international search

17 March 2000

Date of mailing of the international search report

29/03/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Mailliard, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 99/09194

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0149164 A	24-07-1985	DE 3401024 A AT 30865 T	25-07-1985 15-12-1987
WO 8806500 A	07-09-1988	AT 90896 T DE 3882041 A DE 3882041 T EP 0346378 A GB 2229662 A,B US 5348202 A US 5198126 A	15-07-1993 29-07-1993 21-10-1993 20-12-1989 03-10-1990 20-09-1994 30-03-1993
WO 9842465 A	01-10-1998	US 5866022 A AU 6868298 A EP 0969942 A	02-02-1999 20-10-1998 12-01-2000
EP 0282247 A	14-09-1988	DE 3873790 A	24-09-1992

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PCT A183	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/JP99/06872	International filing date (day/month/year) 08 December 1999 (08.12.99)	Priority date (day/month/year) 10 December 1998 (10.12.98)
International Patent Classification (IPC) or national classification and IPC H01L 21/822, 27/04		
Applicant NEC CORPORATION		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
- ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 27 December 1999 (27.12.99)	Date of completion of this report 05 December 2000 (05.12.2000)
Name and mailing address of the IPEA/JP	Authorized officer
Facsimile No.	Telephone No.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/JP99/06872

I. Basis of the report

1. With regard to the elements of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
pages 1-3,6-12, as originally filed
pages _____, filed with the demand
pages 4,5, filed with the letter of 10 August 2000 (10.08.2000)
- ☒ the claims:
pages 2,5, as originally filed
pages _____, as amended (together with any statement under Article 19
pages _____, filed with the demand
pages 1, filed with the letter of 10 August 2000 (10.08.2000)
- ☒ the drawings:
pages 1-11, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language. _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☒ the claims, Nos. 3,4,6,7,8
- ☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/JP 99/06872

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1, 2, 5	YES
	Claims		NO
Inventive step (IS)	Claims	5	YES
	Claims	1, 2	NO
Industrial applicability (IA)	Claims	1, 2, 5	YES
	Claims		NO

2. Citations and explanations

Document 1: JP, 10-107235, A (Hitachi, Ltd.), April 24, 1998 (24.04.98), page 4, left column, line 46 to page 6, left column, line 24; Fig. 1, 2 and Fig. 10 to 15

Document 2: JP, 61-158162, A (Toshiba Corp.), July 17, 1986 (17.07.86), page 3, lower right column, line 18 to page 4, upper right column, line 9; Fig. 4

Document 3: JP, 07-335833, A (Fujitsu Ltd.), December 22, 1995 (22.12.95), page 3, left column, line 37 to page 3, right column, line 29; Fig. 3

Document 4: JP, 62-147745, A (NEC Corp.), July 1, 1987 (01.07.87), Fig. 2

Document 5: JP, 60-066448, A (K.K.Suwa Seikosha), April 16, 1985 (16.04.85), Fig. 3

Document 6: JP, 06-020007, A (NEC Corp.), January 28, 1994 (28.01.94), Fig. 12

Document 7: JP, 64-074737, A (Sanyo Electric Co., Ltd.), March 20, 1989 (20.03.89), Fig. 1 to 4

Claims 1 and 2

The invention disclosed in Claims 1 and 2 does not involve an inventive step in the light of Document 1 cited in the international search report and Document 7 newly

cited in this international preliminary examination report.

The inventions disclosed in Documents 1 and 7 have in common the problem of forming a bypass capacitor on a gate array LSI without any deterioration in packaging density. It would be obvious to apply the configuration of the bypass capacitor disclosed in Document 7 to the invention disclosed in Document 1 in order to solve the above-mentioned problem.

Claim 5

The invention disclosed in Claim 5 involves an inventive step in relation to Documents 1 to 6 cited in the international search report and Document 7 newly cited in this international preliminary examination report.

"A bypass capacitor that is a capacitor wherein one of the electrodes is an FET gate electrode and the other electrode is an metal wiring layer positioned on the upper section of the aforementioned gate electrode by means of a interlayer insulation film, which comprises a capacitor formed by a p-type MOS transistor and a capacitor formed by a n-type MOS transistor, wherein the gate electrode of the capacitor formed by a p-type transistor is connected to the aforementioned power source line and the gate electrode of the capacitor formed by a n-type transistor is connected to the ground line" is not disclosed in any of Documents 1 to 7 and this configuration is not obvious from Documents 1 to 7.

ATENT COOPERATION TREATY

PCT

RECD 20 FEB 2001

FILED PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference DID 15172-WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/EP99/09194	International filing date (day/month/year) 26/11/1999	Priority date (day/month/year) 27/11/1998
International Patent Classification (IPC) or national classification and IPC B22D41/50		
Applicant DIDIER-WERKE AG et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 24/06/2000	Date of completion of this report 16.02.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Flink, E Telephone No. +49 89 2399 2919



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP99/09194

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-8 as originally filed

Claims, No.:

1-9 as received on 26/08/2000 with letter of 25/08/2000

Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP99/09194

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-9
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-9
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-9
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

The object of the invention is to obviate or mitigate the risks of exaggerated thermo mechanical stresses in pouring tube elements (see page 4, lines 14-16).

This object is achieved with the refractory device according to the independent claim 1.

The documents cited in the International Search Report (ISR) do not disclose a refractory device having all the features of the subject-matter of claim 1; in particular they do not mention a refractory device, comprising a ceramic pouring tube element, supported in a metallic can, in which a ceramic support element is encapsulated and a shock-absorbing interface zone between said metallic can and the ceramic pouring tube element.

Further the documents cited in the ISR do not give any indication that the above mentioned object can be achieved with such a device.

Therefore, the subject-matter of claim 1 is novel and involves an inventive step and meets the requirements of Articles 33(2) and 33(3) PCT.

The dependent claims 2-9 relate to further embodiments of the subject-matter of claim 1 and meet likewise the requirements of Articles 33(2) and 33(3) PCT.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document EP-A-0149164 is not mentioned in the description, nor is this document identified therein.

2. The description is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP99/09194

Re Item VIII

Certain observations on the international application

1. Claim 4 referring to claim 3 lacks clarity in that the interface zone of claim 3 already comprises a ceramic material.
2. For consistency with claim 1, the term "support element" in claim 5 should have been replaced by the term "metallic can".

- 1 -

PCT/EP99/09194

CLAIMS

1. A refractory device for use in the teeming of molten metal, comprising a ceramic pouring tube element 10, supported in a metallic can 11, in which a ceramic support element 12 is encapsulated and a shock-absorbing interface zone 13 between said metallic can 11 and the ceramic pouring tube element 10, wherein there is provided a material the thermal properties of which are such that it is substantially solid at ambient temperatures but becomes deformable at elevated temperatures experienced during metal teeming.
2. A refractory device according to claim 1, wherein the material selected for use in the interface zone 13 is structurally solid at temperatures up to about 700°C and becomes deformable without any appreciable chemical degradation at temperatures above about 700 °C.
3. A refractory device according to claim 1 or 2, wherein the material providing the interface zone 13 comprises a pyroplastic ceramic material.
4. A refractory device according to claim 3, wherein the interface zone 13 comprises a ceramic material such as a paste or bonding agent or additional structural ceramic element.
5. A refractory device according to claim 3, wherein the pyroplastic material is a frittable composition applied over at least one of the co-operating assembly surfaces of the pouring tube element and the support element.
6. A refractory device according to any one of the preceding claims, wherein the ceramic support element 12 is fully encapsulated within the metallic can 11, and fits with and around the upper part of the pouring tube element 10 by virtue

AMENDED SHEET

- 2 -

of said ceramic support 12 element having an internal profile corresponding sufficiently to the external profile of the pouring tube.

7. A refractory device according to claim 6, wherein the respective profiles are such as to provide corresponding interferences fits surfaces or otherwise matching.

8. A refractory device according to any one of the preceding claims, wherein the ceramic support element 12 is pre-formed from a ceramic material of low thermal conductivity, or formed in situ by a suitable casting operation.

9. A refractory device according to any one of the preceding claims, wherein the refractory device is finished to suit its intended purpose.

AMENDED SHEET